Lake Nipigon
Fisheries Assessment Unit
Report 1989-2

Status of the Lake Nipigon Commercial Whitefish (*Coregonus clupeaformis*) Fishery and Potential Impact of Rainbow Smelt (*Osmerus mordax*), 1989

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Ontario Ministry of Natural Resources
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ABSTRACT

Ritchie, B.J. 1989. Status of the Lake Nipigon Commercial Lake Whitefish (Coregonus clupeaformis) Fishery and Potential Impact of Rainbow Smelt (Osmerus mordax). Lake Nipigon Fisheries Assessment Unit, Ontario Ministry of Natural Resources, Nipigon. Report 1989-2.

Lake whitefish is the most valuable commerical species harvested by the Lake Nipigon Fish Producers. The approximate dockside value has increased 60% since 1984 due mainly to higher market prices in winter months.

Following the first documented occurrence of rainbow smelt in 1976, smelt have expanded throughout the lake and are particularly abundant in the northwest portion. Annual monitoring of stocks of lake whitefish using index netting and commercial catch samples compared with smelt abundance at the time whitefish are in their first year indicates smelt may be negatively impacting whitefish yearclass strength. As a result, the commercial harvest and numbers caught per gillnet could be reduced. Annual monitoring of smelt and whitefish abundance is required at least until 1994 when whitefish yearclasses hatched during low (1985, 1986) and extremely high smelt abundance (1988,1989) are vulnerable to index netting.

Other characteristics used to monitor the health of whitefish indicate stocks sampled are sustaining current harvest: no increase or decrease in growth; total mortality rate of the 1974-1978 (pre-smelt) cohorts is at or below 50%; Abrosov index has been at least +2 since 1981.

INTRODUCTION

This status report is written with two main questions in mind:

1. What is the health of whitefish stocks?

2. Are whitefish stocks healthy enough to sustain the current harvest as well as the potential increase in mortality due to smelt?

The health of whitefish stocks is evaluated by looking at a combination of population characteristics to see if they all point in the same direction. No single characteristic should be used on its own. This assessment approach is based on Healey (1975).

The main characteristics used here to determine the health of whitefish stocks are:

1. Growth trends for various ages of whitefish.

2. Average age of the commercial catch compared to the age of maturity known as the *Abrosov Index*[1].

3. The number and abundance of mature ages in the commercial catch.

4. Total mortality rates (Fishing + Natural mortality).

5. The abundance of younger ages of whitefish which will be entering the commercial fishery.

6. *Stock*[2] differences with respect to 1-5.

Other important factors taken into account by managers which will be mentioned here are:

1. Health of other species harvested along with whitefish, for example lake trout.

2. Lake Nipigon commercial fishermen report that there is an increased abundance of whitefish.

3. Ability to evaluate and assess changes in whitefish characteristics if harvest levels change and current funding remains the same.

1 The Abrosov Index is the difference between the average age of harvested fish and the average age of maturity. This provides a measure of the average number of years fish will spawn before they are harvested, ideally, at least 2 years.

2 For the purposes of this report, a stock is a portion of the whitefish population which supports fishing pressure and has different mortality, age structure, and growth characteristics compared to other portions of the

PROVINCIAL IMPORTANCE

-Lake Nipigon's commercial whitefish harvest ranked 2nd in the province prior to 1987 and is now 3rd (due to quota increases in Zones 33, 34 in Lake Superior) *(Figure 1)*.

-10 to 12% of the provincial whitefish commercial harvest was reported from Lake Nipigon, 1984 to 1987.

-50% of the total northern inland lake whitefish commercial harvest is from Lake Nipigon.

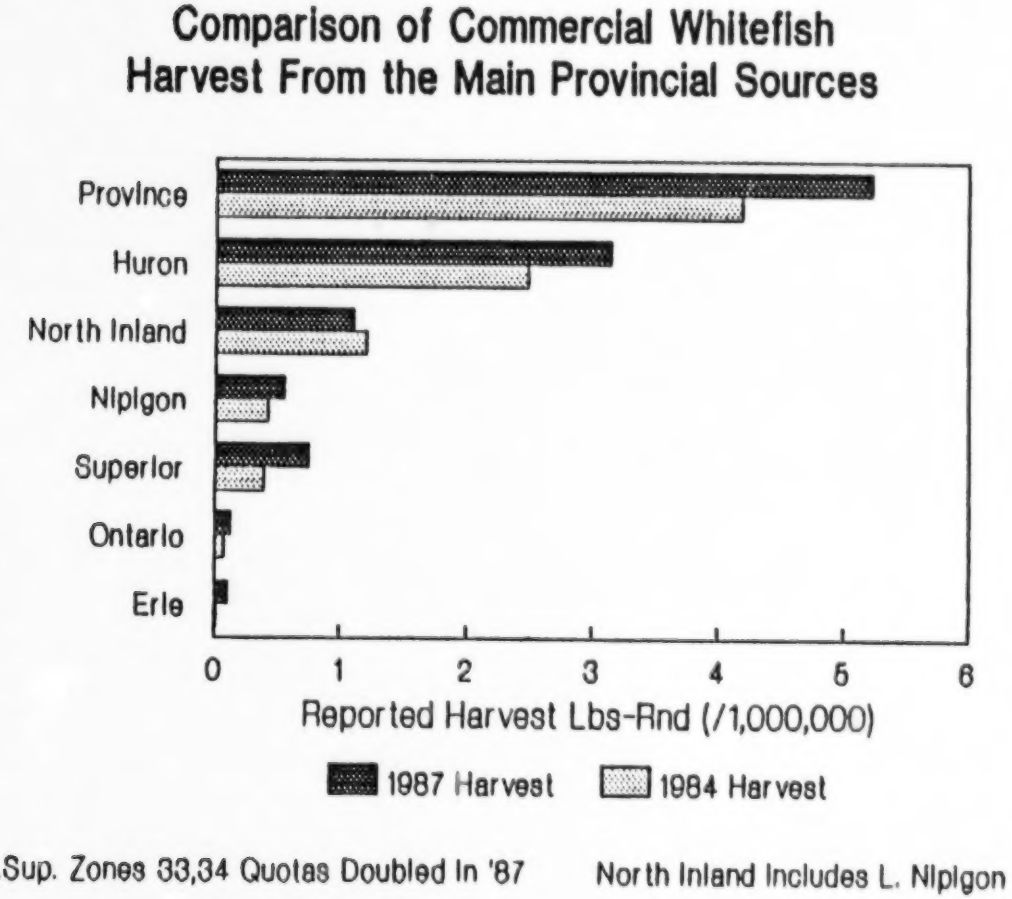


Figure 1

LOCAL IMPORTANCE

-Lake Whitefish is the single most valuable commercial species in Lake Nipigon. The dockside value of whitefish represented 61-64% of the all species value from 1986-1988. For this reason the continued health of this 'bread and butter' species as well as its biological role in the fish community is a high management priority *(Figure 2)*.

-The Lake Nipigon whitefish resource supports 13 licenses of which 2 are Indian Band licenses. All license holders provide employment and important economic support to the communities of Beardmore, Macdiarmid, Nipigon, and Thunder Bay.

-The value of whitefish has increased approximately 60% since 1984 when fishing activity increased in winter months in response to higher market prices *(Figure 3)*.

-The dockside value of whitefish was approximately $379,000 in 1987. This value does not include economic multipliers such as man-months of employment, export revenue, support of local service industries, processing, retail value, etc. The benefactors are not just the commercial fishermen.

Reported Lake Nipigon Commercial Harvest and Dockside Value, All Species

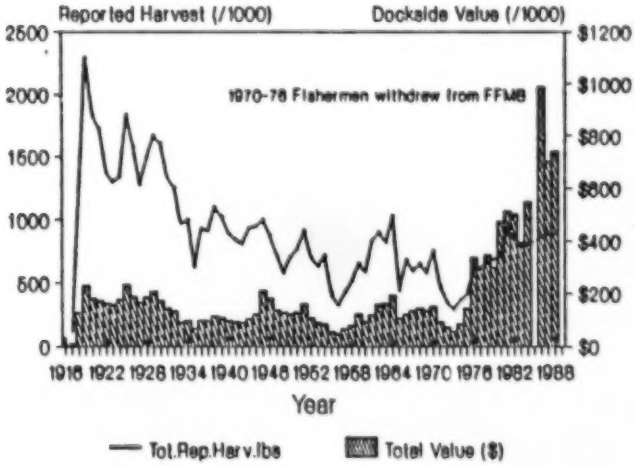
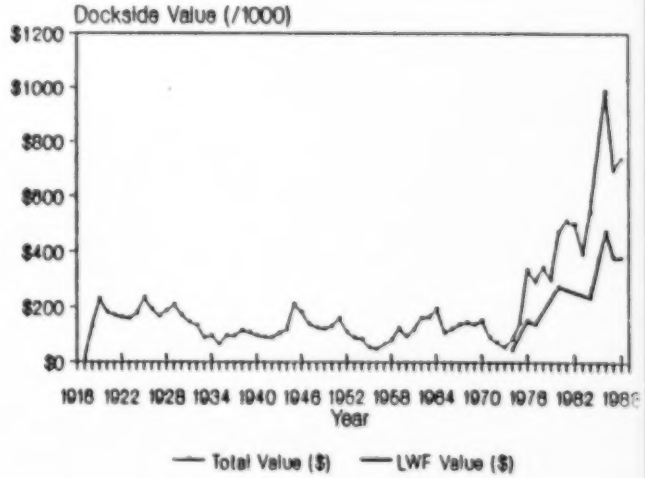


Figure 2

Lake Nipigon Commercial Dockside Value Lake Whitefish VS All Species



Dockside values are approximate.

Figure 3

LNFAU SAMPLING STRATEGY

The Lake Nipigon Fisheries Assessment Unit (LNFAU) relies on three sources of information to assess the health of commercially fished species.

1. Samples of individual fish from commercial landings.

2. Samples of individual fish from a particular whitefish stock using LNFAU index nets.

3. CF-1 reports are used to set sampling targets based on when most fishing activity occurs. (ie. Jan-April and May-July for whitefish and lake trout).

Why does the LNFAU need to use index nets as well as obtain samples from commercial catches?

Commercial samples:
- Whitefish are normally dressed before sampling can be done, so sex and maturity information cannot be determined for the Abrosov Index.

- Commercial samples are from one large mesh size (4.5") and therefore cannot give us information about the abundance of whitefish which will be entering the fishery (forecasting ability), or average age of maturity. This requires obtaining a sample of a range in size of whitefish using standardized index nets which are made up of eight 50 foot panels of graded mesh sizes: 1.5", 2.0", 2.5", 3.0", 3.5", 4.0", 4.5",5.0".

- Samples from commercial nets give us information to determine the average age and number of ages of harvested whitefish from a particular area or potential stock, important characteristics for evaluating the health of fish stocks.

- When sampling of various stocks occurs annually we can look at long term and short term trends. Using trends we can determine when changes are occurring as a result of: fishing or smelt predation versus changes due to natural variation and cycles caused by environmental effects or water level fluctuations and differences between stocks.

Index samples:
- Results provide information to determine age of maturity for both males and females of a particular species stock and growth of whitefish at young ages which are not caught by commercial gillnets. These two pieces of information are essential for assessing the health of whitefish.

-Since whitefish are caught at younger ages in index nets (3-4 years earlier than in commercial gear), we can potentially

detect when a strong hatch or weak hatch (yearclass) has occurred and determine what the impacts might be for the commercial fishery 3 to 4 years later when these yearclasses are large enough to be caught in 4.5" mesh.

-Sex information is important because males usually mature earlier and are smaller than females at the same age. Because females grow faster and are larger at the same age as males they tend to be removed by gillnets at a faster rate when fishing pressure is heavy. Therefore the sex ratio determined from index samples can be another useful indicator of the health of a stock.

-When this sampling is done annually in the same way, as has been done since 1980 by the LNFAU in two whitefish stock areas, trends in maturity and yearclass strength can be used along with commercial data to determine health of whitefish stocks in north and south Lake Nipigon.

STOCK VERSUS POPULATION

Lake Nipigon fishermen recognize that different stocks of whitefish are present based on external appearance and depth distribution.

With the past level of commercial sampling differences between north and south stocks based on ages in the catch, mortality, growth, and average age of the catch were discovered. The increase in catch sampling from other locations, since 1987 should provide the same characteristics from other potential stocks to compare with fishermen's observations. The way data is collected and analysed will be adapted to increased knowledge of whitefish stocks *(Appendix 1)*. At present, the best information available will be used to assess health of whitefish in Lake Nipigon.

Health of individual stocks versus the lakewide population is essential for managing whitefish for sustained catches:
For example: One stock could be declining requiring management and one stock could be increasing but on average there has been no change.

COMMERCIAL SAMPLING

Annual commercial sampling targets are based on the number of landings reported for each license during three seasons (CF-1's) from at least two previous years. For example, if License A reported 10 landings from February to April, 1986 and 12 landings for the same period in 1987, we would plan to sample a minimum of 3 landings or one third of the average number of landings (11) expected in the winter of 1988.

The seasons: Jan 1 to Apr 30 (Whitefish/Lake Trout); May to July 31 (Walleye/Sauger/Whitefish); Aug 1 to Oct 15 (Walleye/Lake Trout) are based on fishing activity and normal target species. *Figure (4)* illustrates the seasonal distribution of the whitefish and lake trout harvest from 1980 to 1987.

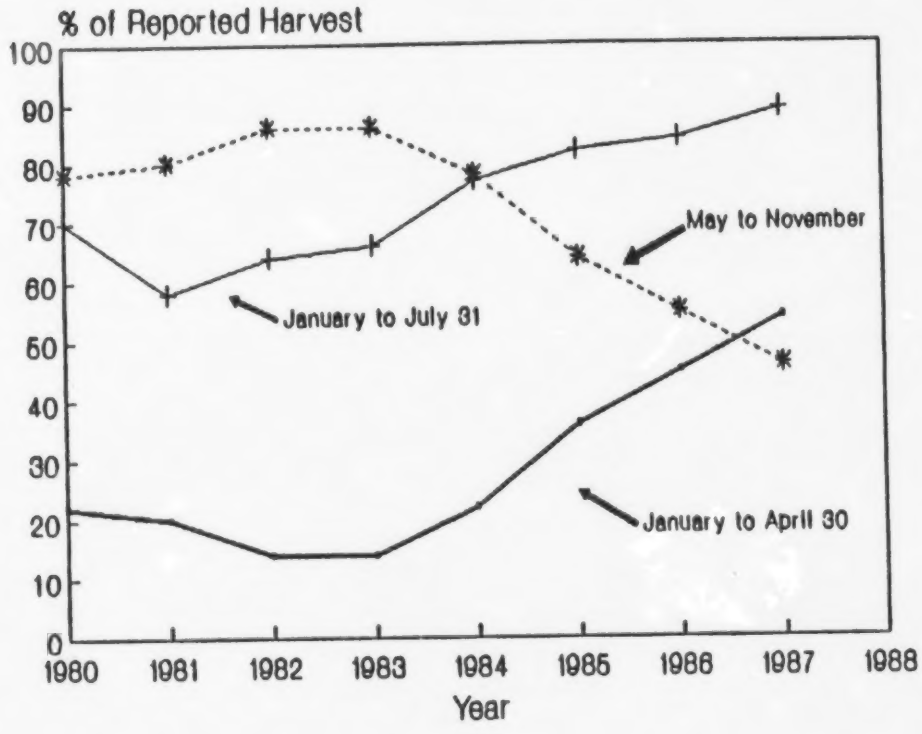
Since 50% or more of the whitefish and lake trout reported harvest is now taken in winter, the LNFAU completes most of its sampling targets for these species at this time (initiated in January 1988).

The following table summarizes the commercial sampling done to generate the population characteristics used in this report. Note that analysis of the 1988 information was not completed for this report, but is included to show the increased level of sampling, ie. increased locations and licenses.

YEAR	SEASON	#LANDINGS	#LICENSES/ FISHERMEN	#LOCATIONS	#FISH SAMPLED
1979-1986	Open-water	NA	Up to 3/8	2	700/yr
1987	"	27	4/9	4	951
1988	Winter	32	9/14	8	1705
	Spr-Sum	43	5/9	7	880
		75			2585

Rocky Bay Development Corporation's 3 licenses are treated as 1 for this summary.

Seasonal Reported Commercial Harvest
Lake Whitefish, 1980-1987



Seasonal Reported Commercial Harvest
Lake Trout, 1980-1987

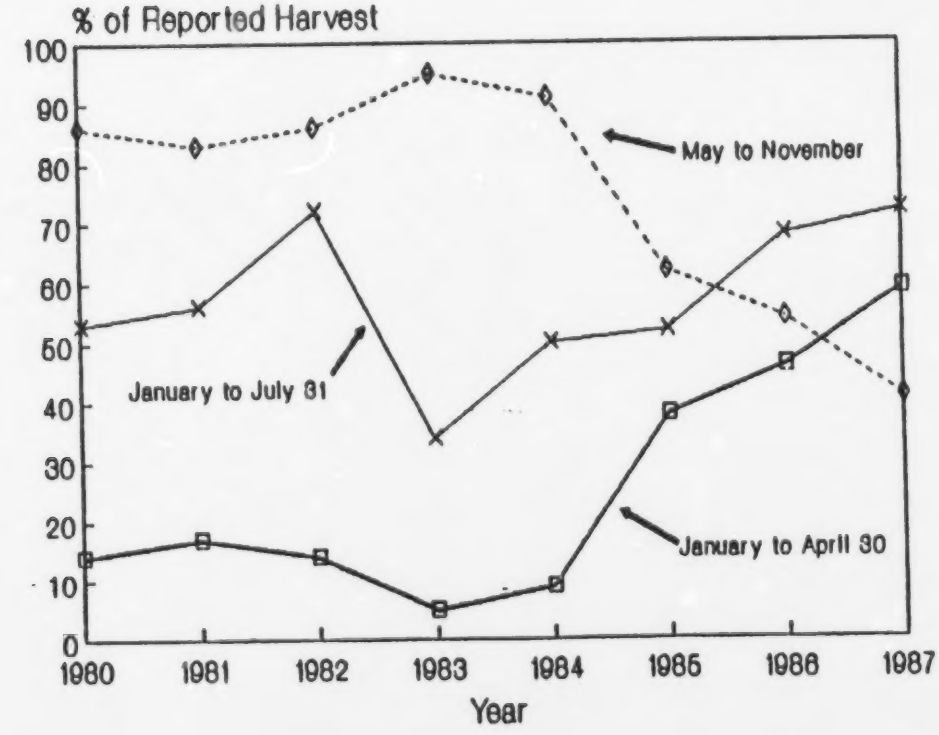


Figure 4

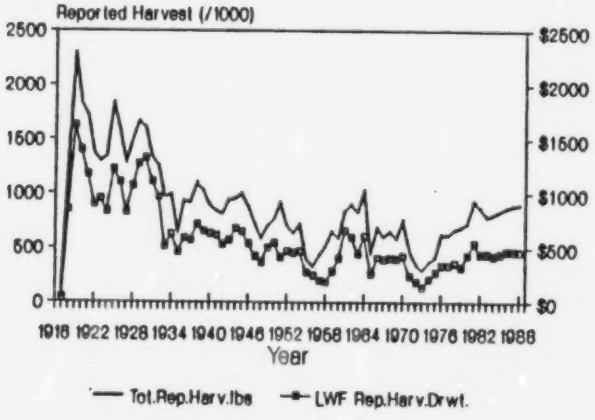
HISTORICAL TREND/RECENT HARVEST

-The historical yield is 1.39 pounds per hectare per year or 0.63 kilograms per hectare per year based on the 1916 to 1973 reported harvest.

-Factors other than fishing pressure affect the harvest such as: demand for food during WW1 and WW2, increased employment in the logging industry, and market prices just to name a few *(Figure 5)*.

Reported Lake Nipigon Commercial Harvest
Lake Whitefish vs All Species

Figure 5



Whitefish Harvest as lbs-dressed.
1988 Whitefish Harvest = Reported + GBIB Reported harvest + GBIB Quota

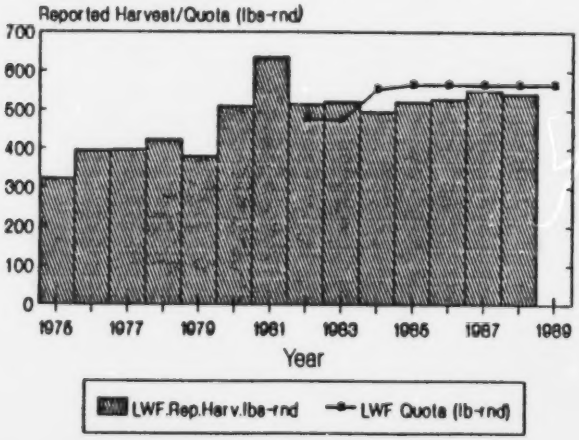
Note: GBIB = Gull Bay Indian Band license.

-Individual species quotas were set in 1982. The current whitefish quota is 565,492 pounds round or 256,507 kilograms round (1.26 lbs/ha/yr; 0.57 kg/ha/yr), approximately 10% lower than the historical yield *(Figure 6)*.

-The reported harvest was 8% and 9% over quota in 1982 and 1983. From 1984 to 1988 the reported harvest has ranged between 90% in 1984 and 97% in 1987. The 1987 harvest was 549,769 lbs-round or 1.23 lbs/ha/yr; 0.56 kg/ha/yr).

Lake Nipigon Commercial Reported Harvest
and Quota for Lake Whitefish 1975-1988

Figure 6



Harvest and Quotas are in lbs-rnd.
1988 Rep. Harv.=491,954 + Gull Bay quota of 50,739 lbs-rnd.

ASSESSMENT OF STOCK(S) STATUS

The following six sections of the report examine each characteristic. Note that all of the characteristics combined are considered to assess health of whitefish stocks.

1. GROWTH

Growth rates of fish are generally related to their abundance. If the rate of harvest is increasing and a reduction in numbers of whitefish occurs, growth rates will usually increase because there is more food availability for those fish remaining. If the harvest rate is not affecting abundance, growth rates will either stay the same or decrease.

Figure (7) shows the trend in length at ages 3 to 10 for male and female whitefish sampled annually from 1980 to 1988 (except 1987), using index nets at two locations: northwest and south Lake Nipigon. In all cases there appears to be no change or a decline in growth for both north and south stocks.

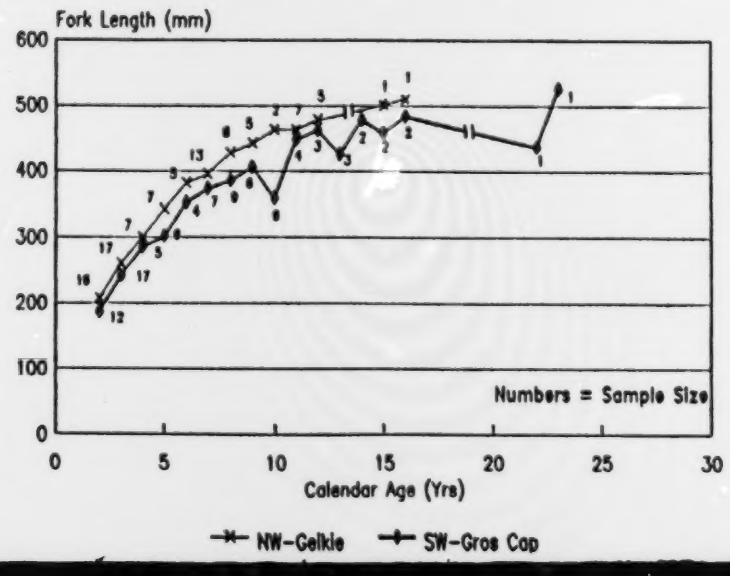
CONCLUSION: Based on growth only, harvest could be increased.

STOCK DIFFERENCES BASED ON GROWTH

-The average length of whitefish at a particular age is longer for northwest whitefish compared to southwest whitefish *(Figure 8)*.

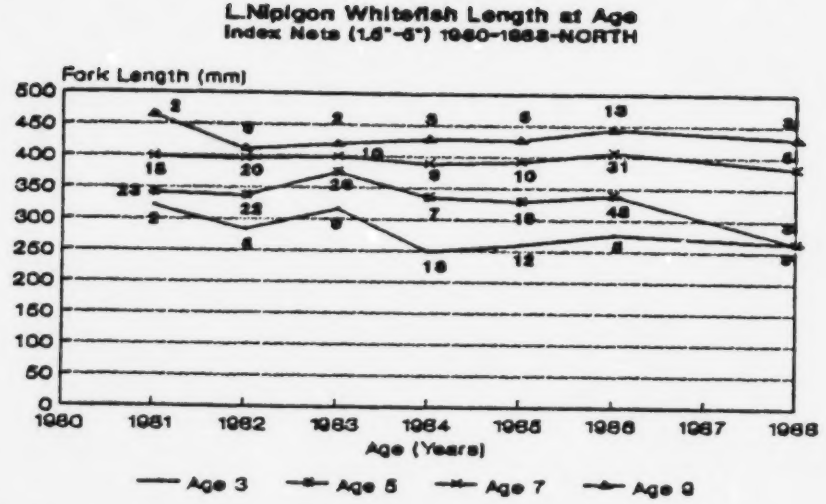
-This difference in growth combined with the fact that the total mortality rate is higher for northern whitefish *(see Section 3)* indicates that the northern stock has probably supported heavier fishing or natural mortality than the south stock. This may be related to fishing pressure or stock differences.

Figure 8

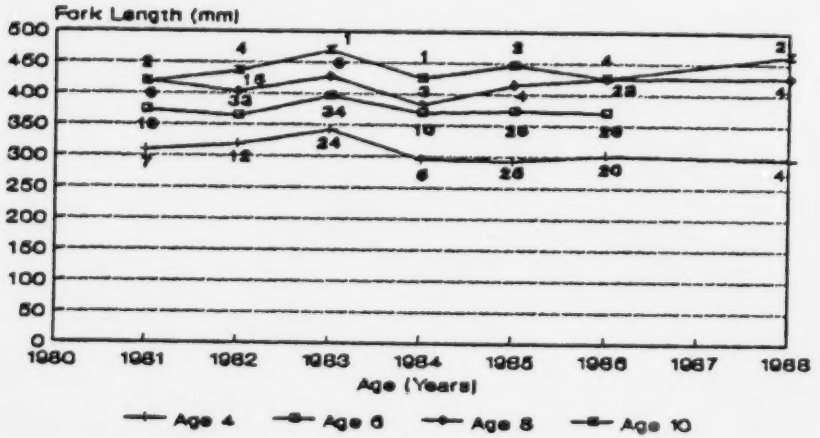


NORTH

Male

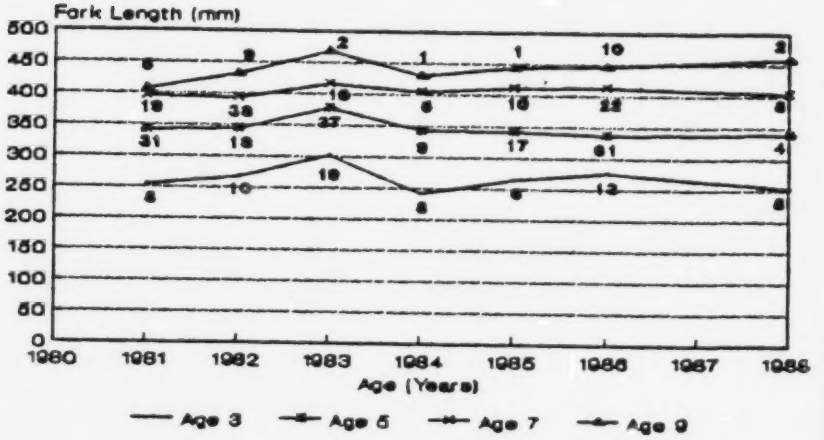


N=North Sector: Males #=sample size

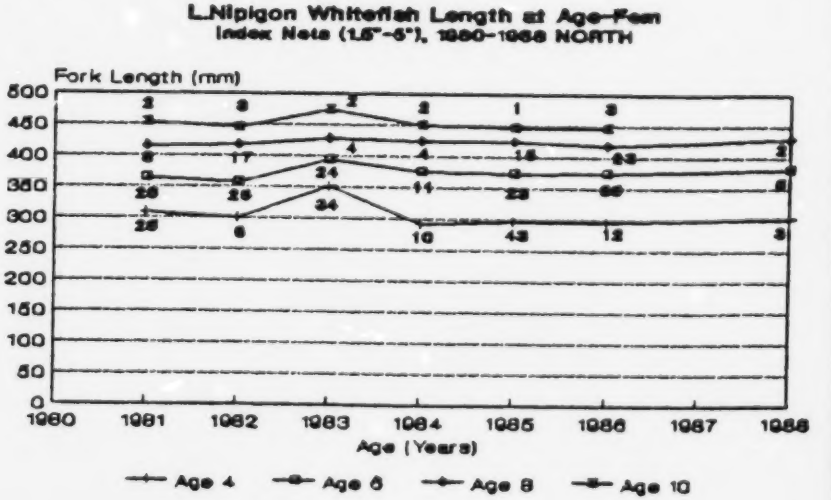


N=North Sector, Male

Female



N=North Sector: Female #=sample size

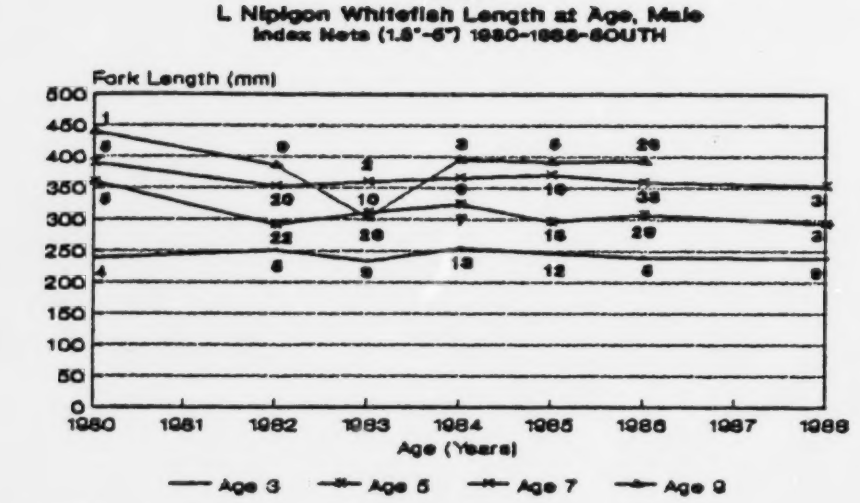


N=North Sector:Female #=sample size

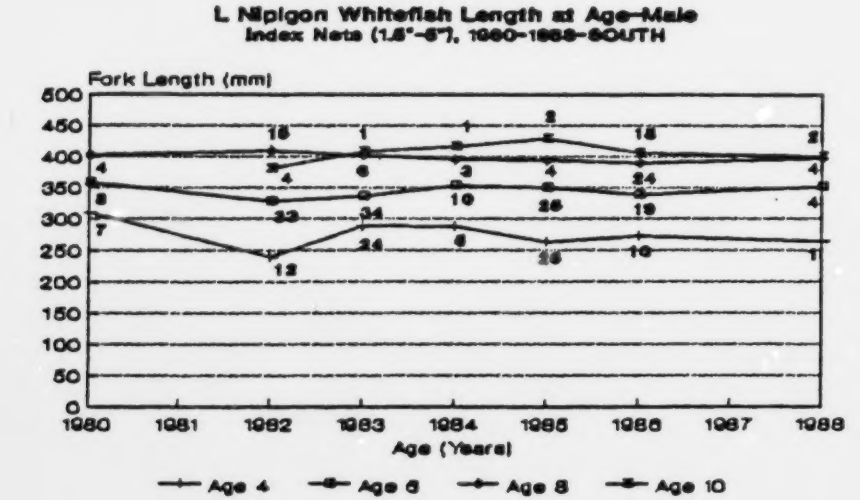
Figure 7

SOUTH

Male

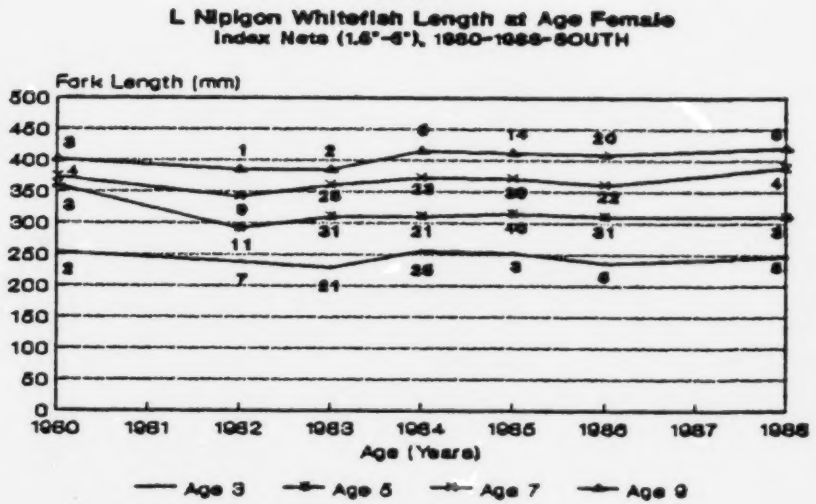


S=South Sector, Male #=sample size

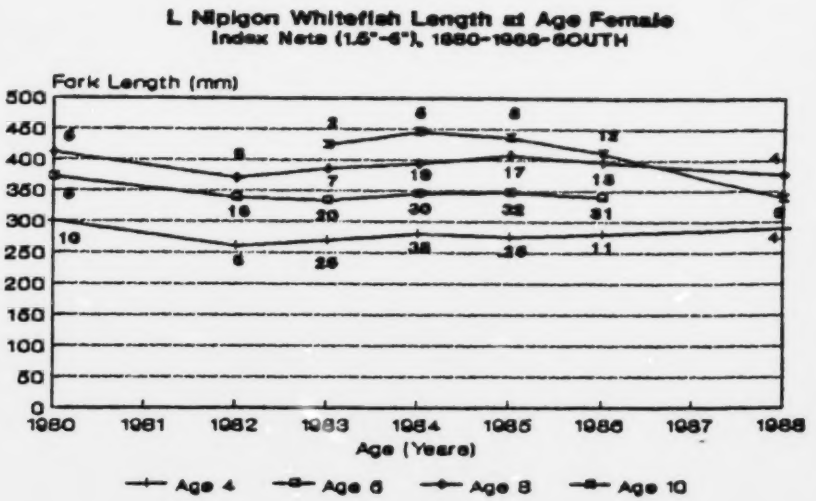


S=South Sector, Male #=sample size

Female



S=South Sector, Female #=sample size



S=South Sector, Female #=sample size

Figure 7 Continued..

2. AGE COMPOSITION OF THE CATCH

As the rate of harvest increases the average age of the catch becomes younger and the number of ages in the catch decreases. Lightly fished stocks have a large number of ages and an older average age than moderately or heavily fished stocks.

The commercial catch should be made up of several ages (or yearclasses) and most of these ages should be older than the age of maturity. The criteria used is: a minimum of 3 ages must contribute at least 15% to the catch; at least 2 of these 3 ages should be 75% mature; the average age of the catch should be a minimum of 2 years older than the average age of maturity to ensure a sustained harvest to the fishery (Christie and Regier 1973; Manitoba Department of Natural Resources in MacCallum 1980).

-The graphs below show the age composition of the 1987 commercial catch from north and south areas. *Appendix (2)* shows the age compositions of 1979 to 1987 commercial catches.

-The current harvest consists mainly of several very abundant ages which were hatched in 1976, 1978, 1979, 1981. Several earlier reports predicted that these yearclasses would be abundant based on index net samples (Savioja 1988; Reid and Savioja 1986; Borecky 1985). This supports the fishermen's assertions that whitefish are very abundant. These yearclasses were hatched before smelt had established significant spawning populations by 1982.

-The mean age of the catch has not decreased and remains at least 2-3 years older than the age of maturity in north stocks and 3 to 4 in south stocks sampled from 1982-1987 *(Table 1)*.

-There are at least 3 to 4 ages contributing 15% to the catch for both north and south stocks sampled. There are also whitefish aged 12 to 17+ years in both areas sampled, based on fin ray sections.

CONCLUSION: Harvest levels could be increased based on mean age of the catch versus maturity and the presence of older ages up to at least 17 yrs in the catch.

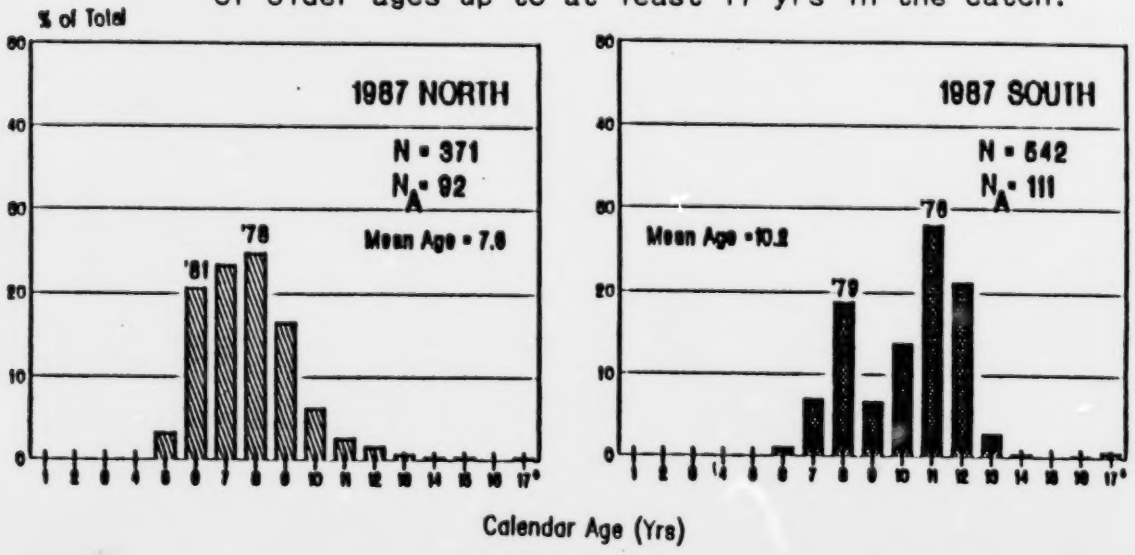


Table 1. **LAKE NIPIGON COMMERCIAL WHITEFISH - ABROSOV INDEX**

	NORTH				SOUTH			
	#1	#2	#3	#4				
YEAR	MEAN AGE OF CATCH	# AGES >15% OF CATCH/75% MATURE	MEAN AGE OF MATURITY	ABROSOV INDEX	MEAN AGE OF CATCH	# AGES >15% OF CATCH/75% MATURE	MEAN AGE OF MATURITY	ABROSOV INDEX
1979	6.2 +/- 1.50	3			7.4 +/- 1.18	3		
1980	6.7 +/- 1.34	3			8.6 +/- 1.31	4/4		
1981	7.1 +/- NA	3/3			NA			
1982	7.6 +/- 1.10	3/3	5.06	2.54	8.6 +/- 1.36	3/3	5.47	3.13
1983	7.2 +/- 1.19	3/3	3.75	3.45	7.7 +/- 1.34	4/3	6.06	1.64
1984	7.1 +/- 1.20	3/3			7.5 +/- 1.20	3/2	5.83	1.67
1985	6.2 +/- 1.20	3/1	5.64	0.56	7.9 +/- 1.17	3/3	6.50	1.40
1986	8.2 +/- 1.95	2/2	5.72	2.48	8.5 +/- 1.44	4/3	6.27	2.23
+	8.7 +/- 1.49 (FAU)	3/2	5.72	2.98				
1987	7.6 +/- 1.5	4/2	5.47*	2.13	10.1 +/- 1.69	3/3	6.38*	3.72
					10.2 +/- 2.04	4/3	6.38*	3.82
IDEAL		(3/2)		(1.5-2.0)		(3/2)		(1.5-2.0)

#1 Average age of commercially caught whitefish +/- the standard deviation. Ideally the mean age of harvested fish should be 1.5 to 2.0 years older than the average age of maturity (Christie and Regier 1973). See #4 below.

#2 The Manitoba Department of Natural Resources recommends that three whitefish yearclasses should contribute to the commercial harvest (a contribution is defined as at least 15% of the age composition) and that two of these year classes should be at least 75% mature (In: MacCallum 1980). These values mean that fishermen can rely on long term sustained catches year after year.

#3 Average age when whitefish mature in Lake Nipigon as determined from Lake Nipigon FAU index netting studies. See #4 below.

#4 This index is the average age of whitefish in the commercial catch (#1) minus the average age of maturity (#3). A difference of 1.5 years or greater is indicative of a stock which can replace what is removed by fishing and natural causes of mortality (ie. smelt predation, environmental conditions, wind, etc.).

* 1988 index net data: North = Geikie area; South = Gros Cap-Shakespeare area.

3. TOTAL MORTALITY RATES

Total mortality is the number or percent decline of fish due to both natural causes and fishing during a time period, in this case one year. Generally, total mortality of whitefish should be no higher than 50% to ensure that enough of the population remains to reproduce and provide a longterm sustained harvest with minimal variation from year to year (OMNR 1983).

Total mortality is estimated using a representative sample of the number of whitefish at each age. This can be obtained from an index net sample. Mortality estimates from one year's index netting tend to be affected by weak and strong yearclasses such as in 1976 and 1981 and can therefore result in unrepresentative rates (referred to as a 'point in time' estimate).

Since the LNFAU has standardized annual samples for 8 years, a better estimate of mortality can be determined by following the abundance of whitefish which hatched in the same year, known as a yearclass, as they age. For example, to determine the total mortality of whitefish hatched in 1974, the abundance of this yearclass must be measured each year from 1980 to at least 1984 as they increase in age from 6 to 10 years. To determine mortality for the 1981 yearclass, data on their abundance at ages ranging from 6 to 10 years would be required from annual index netting beginning six years later, from 1987 to 1991.

The following table summarizes mortality rates based on the yearclasses of whitefish hatched before smelt became established (by 1982). In order to determine mortality rates for whitefish hatched during high smelt abundance (1982 to 1984), annual sampling must be continued at least until 1994.

YEARCLASS	MORTALITY (AGES USED)	
	Northwest	South
1974	54% (8-10)	47% (8-10)
1975	51% (8-10)	54% (7- 9)
1976	47% (6-10)	46% (7- 9)
1977	33% (7- 9)	NA
1978	38% (6-10)	18% (6-10)
1974-78	**50% (7-10)**	**34% (7-10)**

CONCLUSION: There will always be a lag of at least six years for estimating mortality rates. Fortunately, other characteristics such as growth rate, age of maturity, and average age of the commercial catch can be used to assess health of whitefish.
If smelt impacts whitefish by adding to total mortality, current harvest levels might not be sustainable. The potential impact of smelt should be identified by 1994.

4. YEARCLASS STRENGTH/FORECASTING

The following figures show the age composition of whitefish sampled with index nets in northwest and south Lake Nipigon from 1980 to 1988 (except 1987). Until 1988, ages 5 and 6 are usually the most abundant ages in index nets (ie. fully recruited) *(Figure 9)*.

-The strong 1976, 1978, and 1981 yearclasses which are currently being harvested by the commercial fishery at ages 6 to 11 were predicted to be strong two to four years ago from the 1982 to 1985 index netting results.

-It is apparent from the 1988 index net age composition that the 1982 to 1984 yearclasses are very weak. Therefore, there is a probability that this will impact the fishery since the commercial catch is largely made up of 3 ages in most years, as stated earlier.

-It appears that the 1985 and 1986 yearclasses are strong but will not be caught by index netting until 1991. The high abundance of these yearclasses may lower the impact of the weak 1982 to 1984 yearclasses on the commercial harvest in 1990-1992. The 1982 to 1984 yearclasses will be aged at 6 to 8 years at this time and will be large enough to be caught in 4.5" commercial gillnet mesh.

-Healey (1980) noted that in relatively lightly or unexploited whitefish populations, an abundant population of old fish somehow suppresses the younger fish. The fact that the high abundance of the 1976 to 1981 pre-smelt yearclasses at ages 7 to 10 years are followed by a low abundance of younger fish (1982-1984 yearclasses) may support this hypothesis. However, the strong connection between high smelt abundance years and coincidental low abundance of whitefish hatched in those years as well as low smelt abundance years and coincidental high whitefish abundance means smelt may have a more significant impact on whitefish than can be explained by variation due to whitefish yearclass abundance.

CONCLUSION: Annual index netting appears to provide forecasting ability at least for predicting when strong yearclasses will enter the commercial fishery.

Annual assessment of both smelt abundance and whitefish yearclass strength will be required at least until 1994 to determine if the link between smelt and whitefish abundance remains consistent. Coincident monitoring of the commercial catch will determine impacts of weak whitefish yearclasses on harvest.

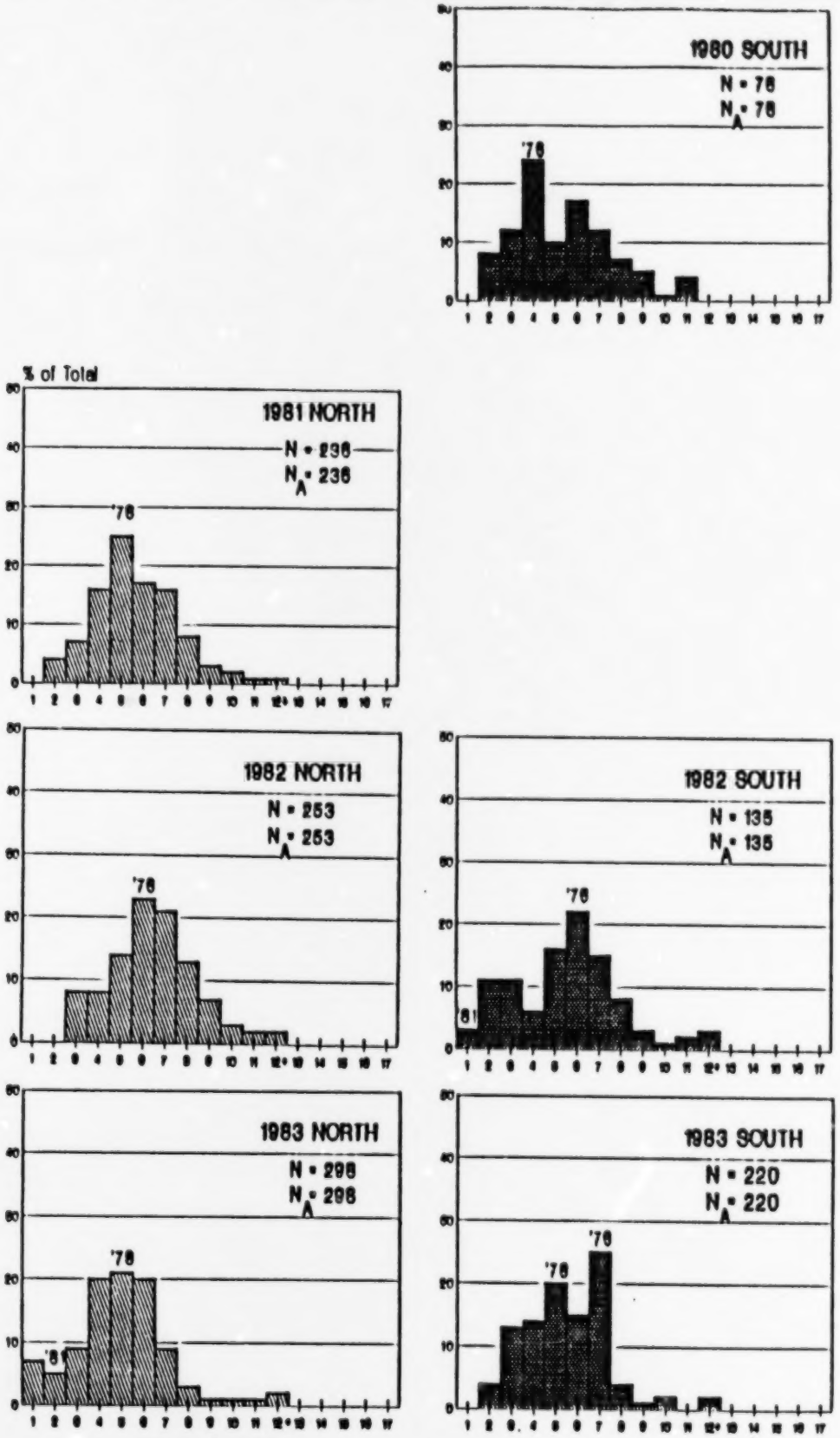

1980 SOUTH
N = 76
N_A = 76
'76
% of Total
1981 NORTH
N = 236
N_A = 236
'76
1982 NORTH
N = 253
N_A = 253
'76
1982 SOUTH
N = 135
N_A = 135
'76
'81
1983 NORTH
N = 298
N_A = 298
'76
'81
1983 SOUTH
N = 220
N_A = 220
'76
'76
Age (yrs)

Figure 9

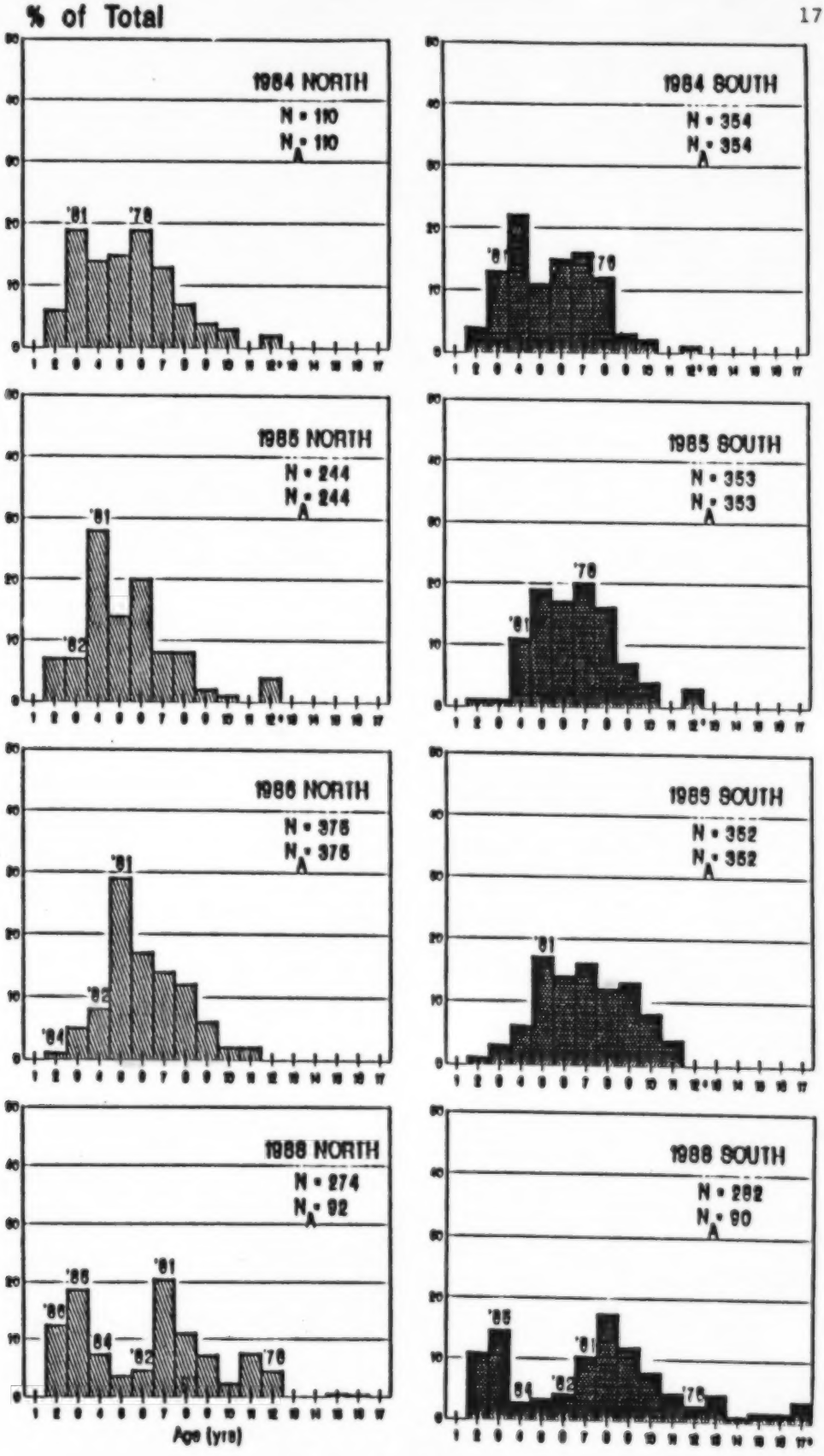


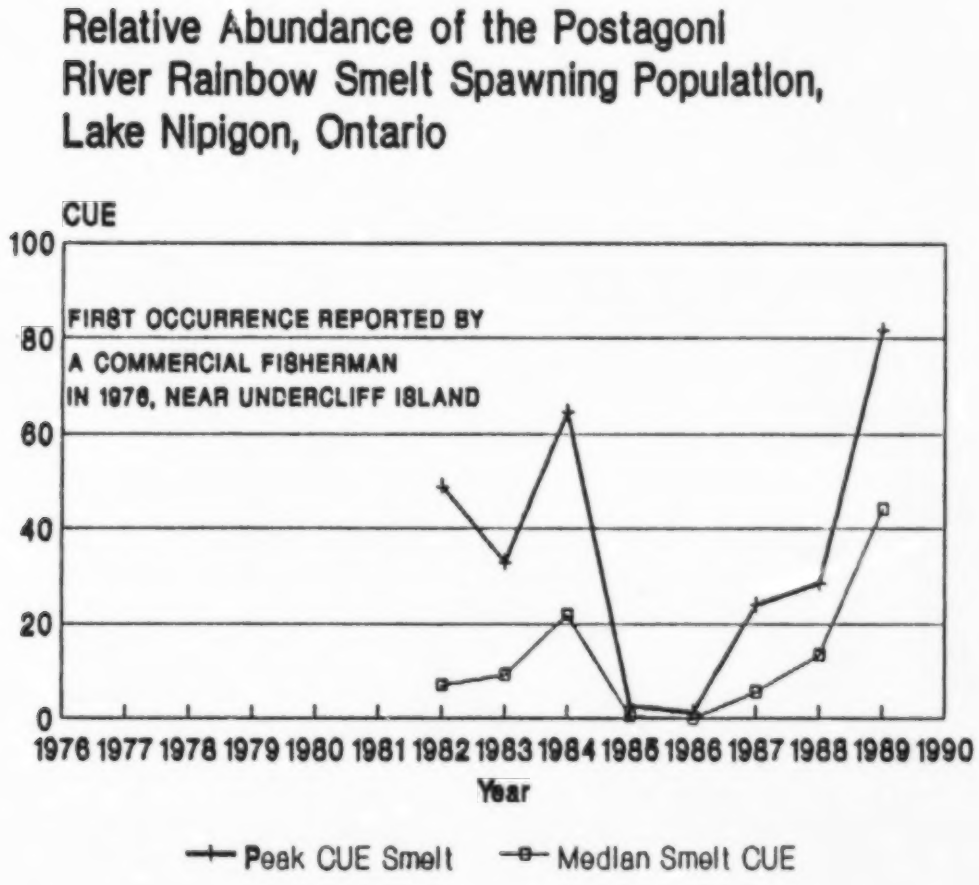
Figure 9 Continued..

5. POTENTIAL SMELT-WHITEFISH INTERACTION

The LNFAU monitors the relative abundance of rainbow smelt during spawning at the Postagoni River, at the Macdiarmid MNR Base.

-The first documented occurrence of smelt was in 1976 in northwest Lake Nipigon.

-Smelt abundance was high in 1982 and 1983, peaked in 1984, and following a summer die-off in 1984 was extremely low in 1985 and 1986. By 1987, the spawning population had increased in abundance. In 1988, the second largest spawning run occurred as measured by the median daily catch and the 1989 run was the largest on record, approximately 30 to 40% larger than in 1984 *(Figure 10)*.



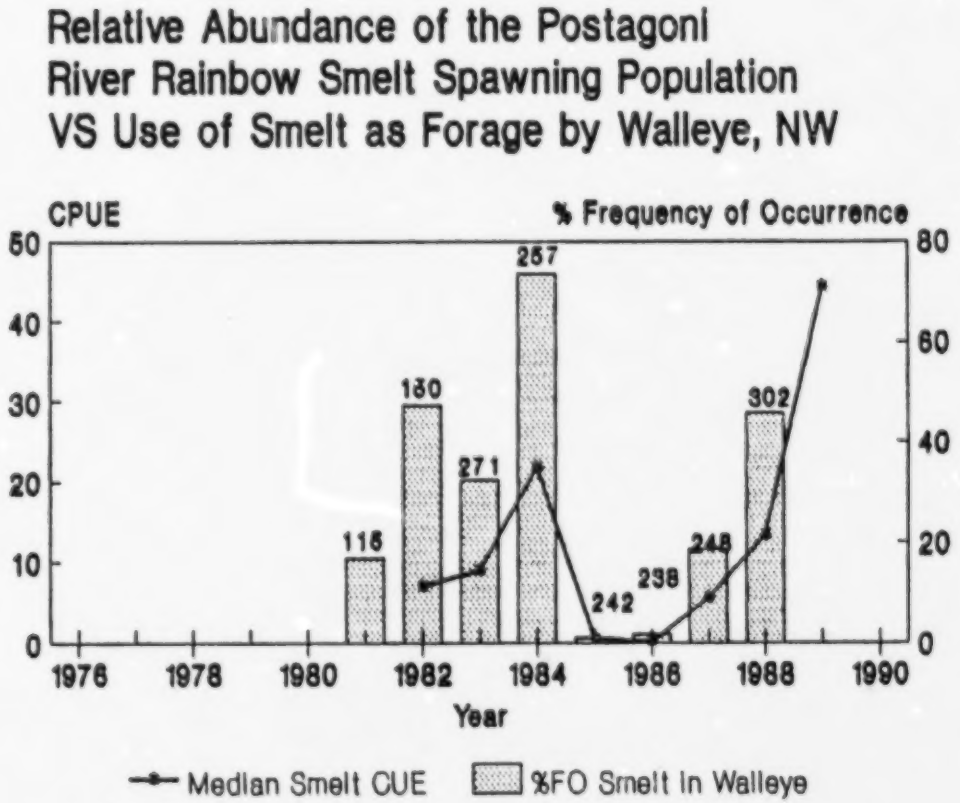
CUE= #/10m/night of 1" multi-gillnet

Figure 10

A. HOW DO WE KNOW THAT THE POSTAGONI RIVER SPAWNING POPULATION ABUNDANCE IS REPRESENTATIVE OF SMELT ABUNDANCE IN LAKE NIPIGON?

The LNFAU annually monitors the use of smelt as forage by walleye in the Wabinosh area. The use of smelt is estimated as: the number of walleye stomachs with identifiable contents which contain smelt. This is referred to as the percent (%) frequency of occurrence of smelt.

By comparing % frequency of occurrence of smelt found in walleye approximately 60 miles away with smelt spawning abundance it is apparent that the relative abundance of the Postagoni River spawning run is a good indicator of lakewide abundance because the abundance trends indicated by the two assessment techniquess are the same *(Figure 11)*.



CPUE= Median #/10m/night of 1" multi
Numbers indicate # stomachs examined
FO=# stomachs with contents and smelt

Figure 11

B. WHITEFISH YEARCLASS STRENGTH VS SMELT ABUNDANCE

Figure (12) on the facing page shows the relative abundance of different ages of the northwest and south whitefish stocks determined from 1988 index netting and smelt abundance determined from annual index netting from 1982 to 1989. Whitefish age is presented as the year of hatch. For example, age 5 whitefish are labelled 1983, the year they would have hatched.

The lower axis (X) shows the year of whitefish hatch and the upper axis (Y) shows the % contribution or abundance of each yearclass. For example, the 1980 yearclass is shown as the most abundant at age 8 in the 1988 sample while the 1984 yearclass is shown as the least abundant at age 4 in the 1988 sample. The 1985-1988 yearclasses are not fully vulnerable to our gillnets until 1990-1993.

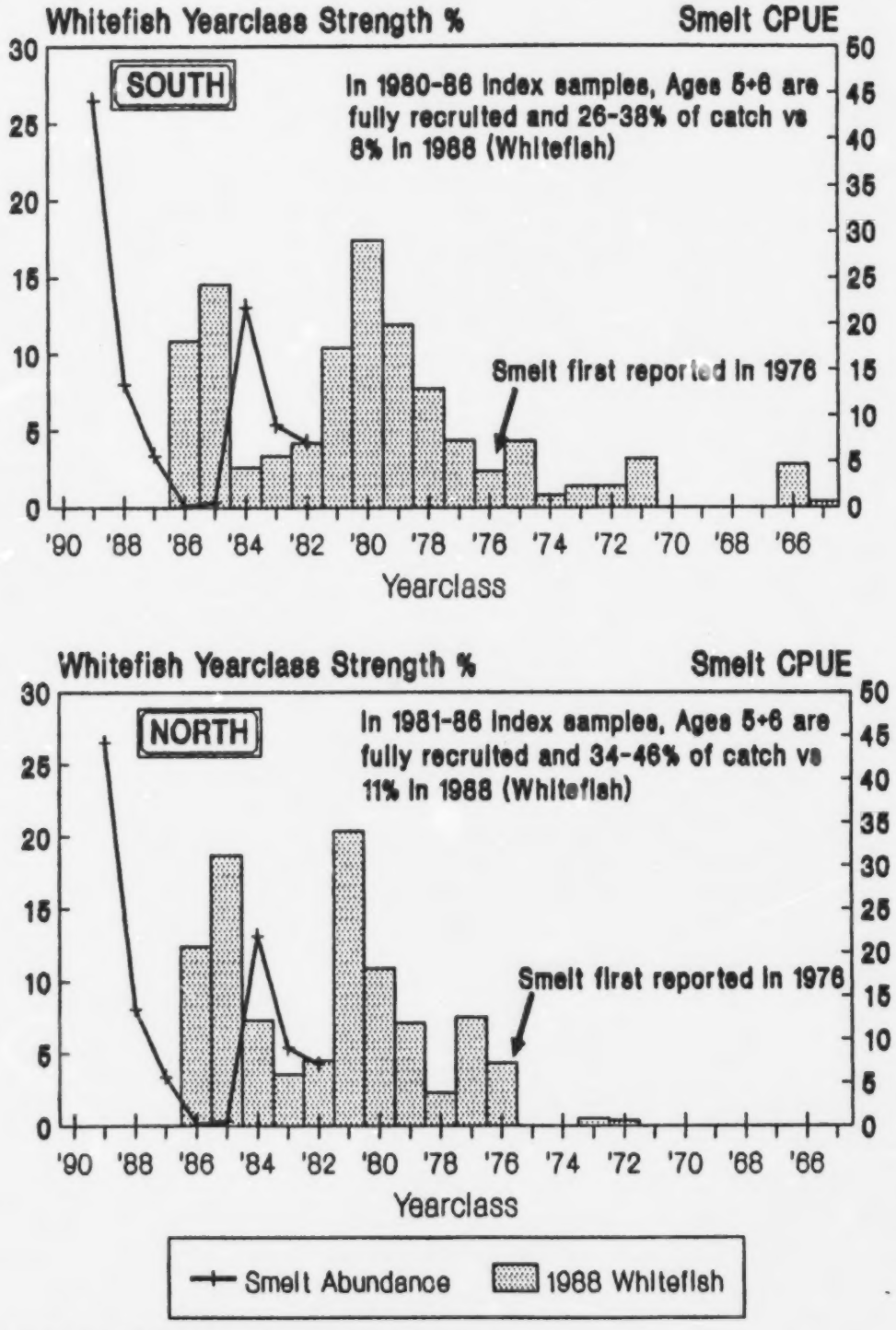
The smelt abundance in the year of hatch for whitefish yearclasses 1982 to 1989 is shown by the solid line.

-The 1982-1984 whitefish yearclasses hatched when smelt were most abundant, while the 1985 and 1986 yearclasses hatched when smelt were least abundant. If this interaction is affecting whitefish abundance, then the 1987 and 1988 yearclasses will be weak or low in abundance.

-We will not be able to fully determine the resulting impact on the commercial harvest unless annual index and commercial catch sampling continues until 1994, when the 1982-1986 yearclasses are being harvested and the abundance of whitefish hatched in 1987, 1988, and 1989 can be determined from LNFAU index netting.

Note that in Lake Ontario, the abundance of top predators has increased (ie. walleye, lake trout, salmon) contributing to the decline in larger-sized smelt. Coincidently, lake whitefish abundance has increased significantly (Dr. J. Casselman, Research Scientist, OMNR, personal communication).

Relationship Between Smelt Abundance and Lake Whitefish Yearclass Strength



Yearclass strength= % contribution to index net samples, 1988 Gros Cap,Geikie
CPUE=Median #/10 m 1.0" mesh, overnight

Figure 12

6. LAKE TROUT HARVEST

Lake Trout is the main commercial species of value harvested along with lake whitefish in Lake Nipigon.

-During the period 1980 to 1985 and in 1987 the seasonal lake trout harvest can be as high as 49% of the whitefish harvest between early August and October, the lake trout pre-spawning and spawning period.

-By the beginning of August, 80 to 90% of the whitefish and 70-80% of the lake trout reported harvest has occurred (Based on 1985-1987 commercial data; *Figure 13).*
Note that 1986 was excluded when a cooperative study was done, which is not representative of normal fishing activity.

Previous reports on Lake Nipigon lake trout status indicate that those lake trout stocks which have been sampled are heavily exploited (Reid 1987; Borecky 1985):

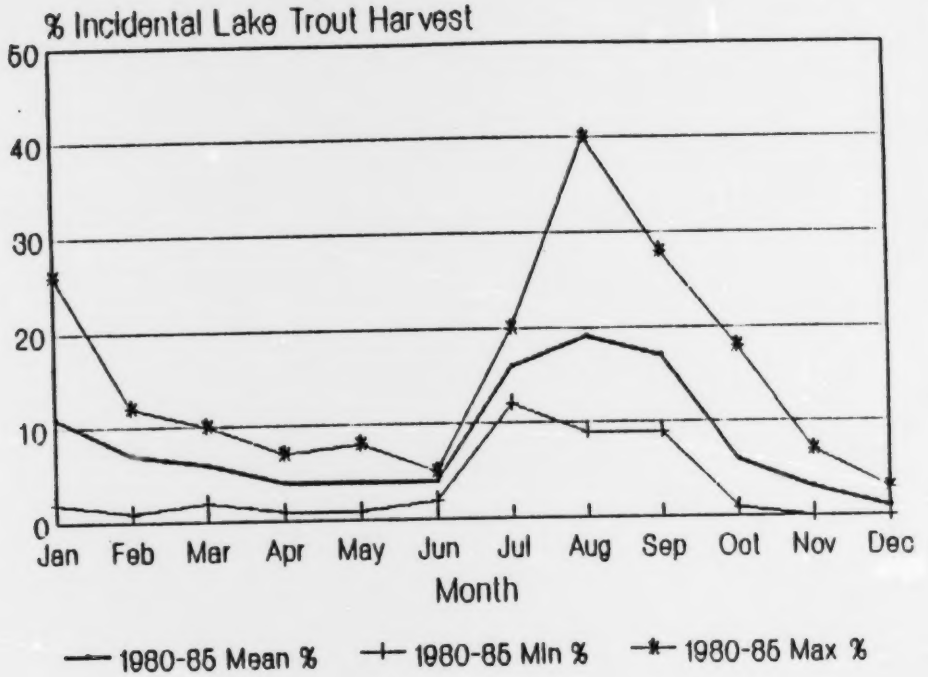
- Mean age of the catch has declined and is lower than or equal to the age of maturity. (Abrosov index ranges between -1 and +1; Ideally it should be at least +2).
- Fast growth relative to another Lake Nipigon stock which is lightly exploited (South Bay).
- Mortality is above 50%
- Two ages, each contribute 15% to catch and few fish in the catch older than 9 years.

CONCLUSION: The health of the lake trout stocks sampled indicates that current harvest levels may be too high to ensure longterm sustained harvest.

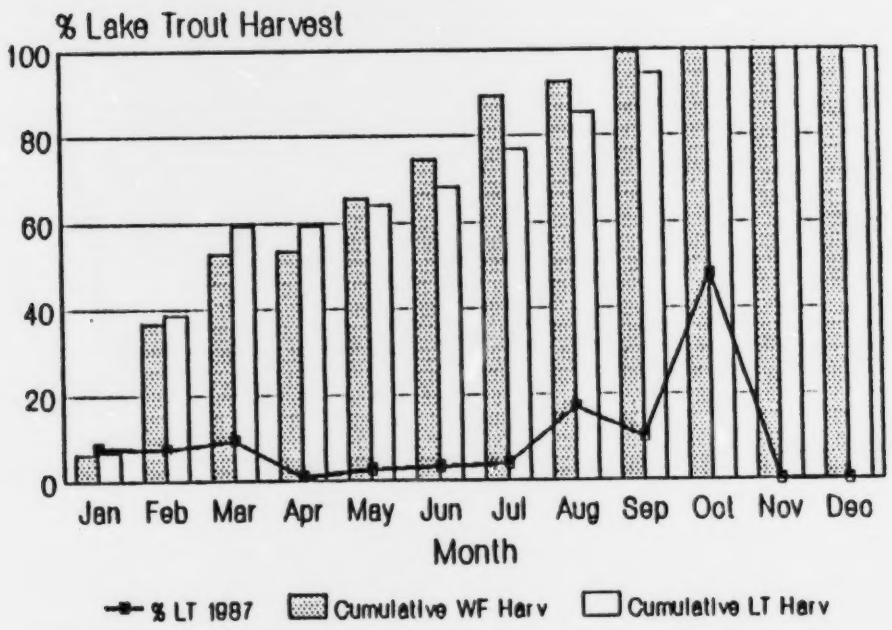
Some stocks are being fished during pre-spawning and spawning periods. Fishing pressure at this time when lake trout congregate can lead to the 'fishing-up'[1] of lake trout stocks which happened on the Great Lakes before season regulations were in place. The result of 'fishing up' causes a reduction in genetic variability and stock diversity essential for providing lake trout with the ability to adapt to changing conditions such as: water quality, habitat degradation, species introtions, and water level fluctuations.
Note that the season closure on Lake Nipigon for protection of whitefish during spawning has worked well toward providing consistent annual catches to fishermen.

1 Fishing up means the sequential harvest and depletion of individual spawning stocks which normally occurs when stocks are segregated and concentrated on spawning shoals.

As % of Reported Lake Whitefish Harvest



Seasonal Lake Trout Harvest as % of Lake Whitefish Harvest VS Cumulative Harvest of Lake Trout and Whitefish 1987



From CF1 Reports, all licenses

Figure 13

SUMMARY

1. The population characteristics examined indicate that whitefish could sustain an increased harvest level but the impact of smelt on the commercial whitefish will not be known at least until 1994.

2. Lake trout cannot sustain an increased harvest and those stocks sampled are at risk under current pressure.

3. Whitefish sampled from north locations show signs of higher harvest rates when compared to those sampled from south locations.

   These characteristics are: Faster Growth
   Higher Mortality
   Younger Average Age of Catch
   Younger Average Age of Maturity
   Abrosov Index is 1 year less

4. Index netting by the LNFAU can be used to predict when strong yearclasses will affect the commercial harvest, as is occurring now. The increased abundance of whitefish reported by fishermen is largely due to several strong yearclasses: 1976, 1978, 1979, 1981 and the quota set at a sustainable harvest level.

5. The relationship between smelt abundance and whitefish yearclass strength will be verified by 1994 if annual index netting and commerial catch sampling continues. Preliminary data indicates smelt will impact whitefish abundance and increase total mortality.

RECOMMENDATIONS FOR ASSESSMENT/RESEARCH

1. The standardized index netting study of northwest and south whitefish stocks must be continued annually at least until 1994 to determine the impact of smelt on the abundance of whitefish. This will ensure that the abundance of whitefish hatched when smelt were high in number (1982-1984, 1987-1989 yearclasses) and when smelt were low in number (1985, 1986 yearclasses) will be measured.

2. A smelt trawling and coincident larval whitefish abundance study should be done at a known whitefish spawning area to monitor smelt-whitefish interactions directly.

3. Standardized index netting for three sequential years every 5 to 10 years should be done to assess the health of other key whitefish stocks.

4. Detailed analyses of growth and age structure should be done on commercial catch data collected in 1988 and 1989, when up to 7 fishing areas were sampled to assess stock differences. Commercial samples collected periodically back to the 40's should be analysed for age specific growth patterns related to environmental conditions and fishing pressure using backcalculation. The results should be compared with fishermen's observations and assessment programs designed accordingly.

5. Whitefish tagging studies with the cooperation of Lake Nipigon commercial fishermen would provide valuable information on stock differences, inventory of spawning habitat, and movements.

6. Current catch sampling is of landings only. In order to measure the effects of whitefish yearclass abundance on harvest and ensure accurate location information is obtained for catches sampled, a cooperative onboard sampling and catch/effort program should be initiated as soon as funding permits.

RECOMMENDATIONS FOR MANAGEMENT

1. In order to ensure that the impact of smelt on the commercial whitefish harvest is measured, no significant quota changes should be considered until 1994. As a result, the allowable whitefish yield can be set to minimize annual variation so fishermen can rely on consistent catches and income year to year.

ACKNOWLEDGEMENTS

I am grateful to Tom Savioja, Marco Grigio, Jeff Black, Bob Johnson, and Tim Riordan for their contributions to field and commercial catch sampling, data compilation, fish aging. Tom Savioja summarized most of the information prior to 1987.

North Shore Environmental Services carried out a large portion of the commercial catch sampling and fish aging in 1988 and will continue through to 1991.

Betty Bartlett provided valuable assistance in preparing annual summaries of commercial harvest reports.

The constructive comments provided by Art Currie, Rob Swainson, Rick Salmon, Lorne Townes, Blake Beange, and Dr. Peter Colby were greatly appreciated.

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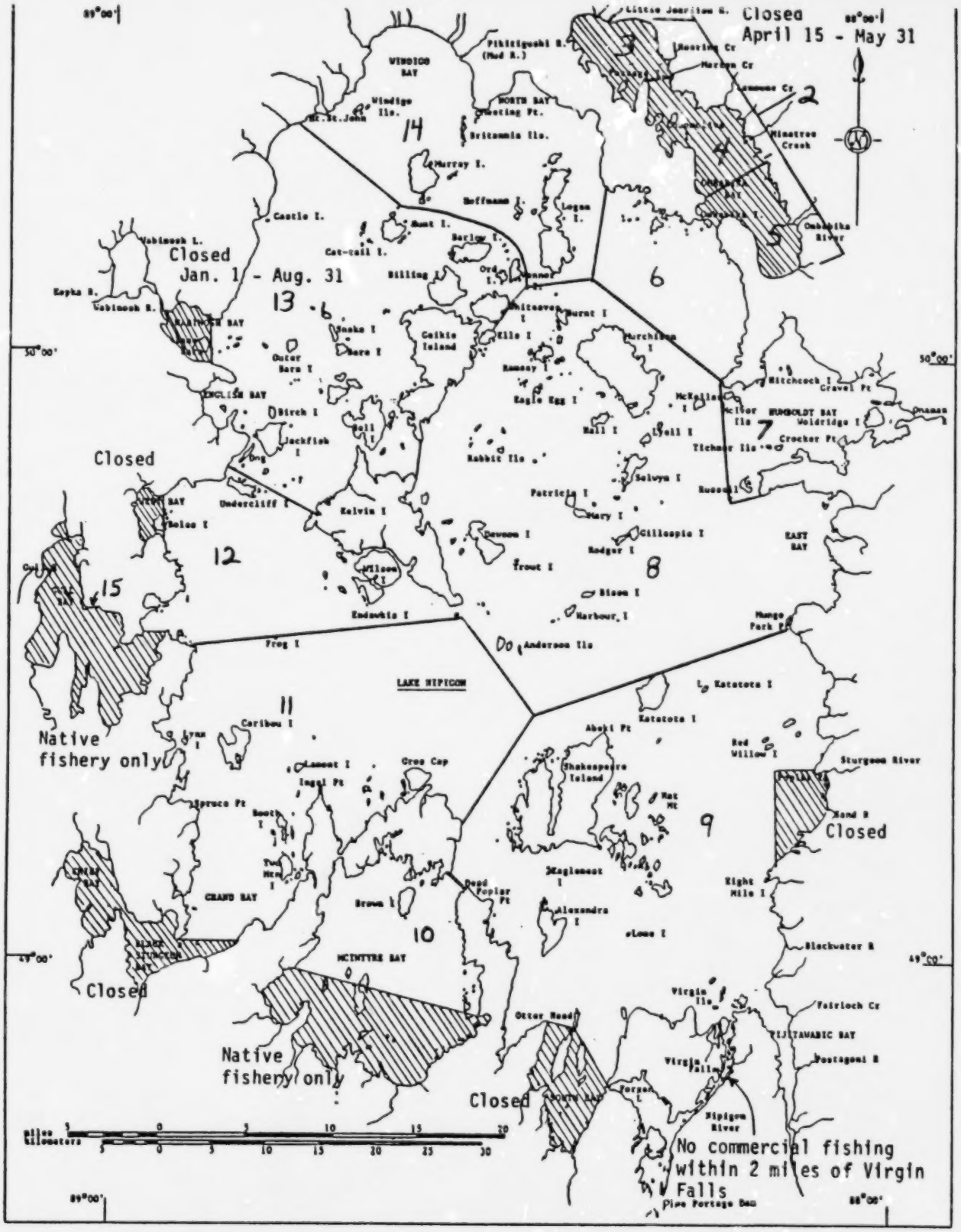
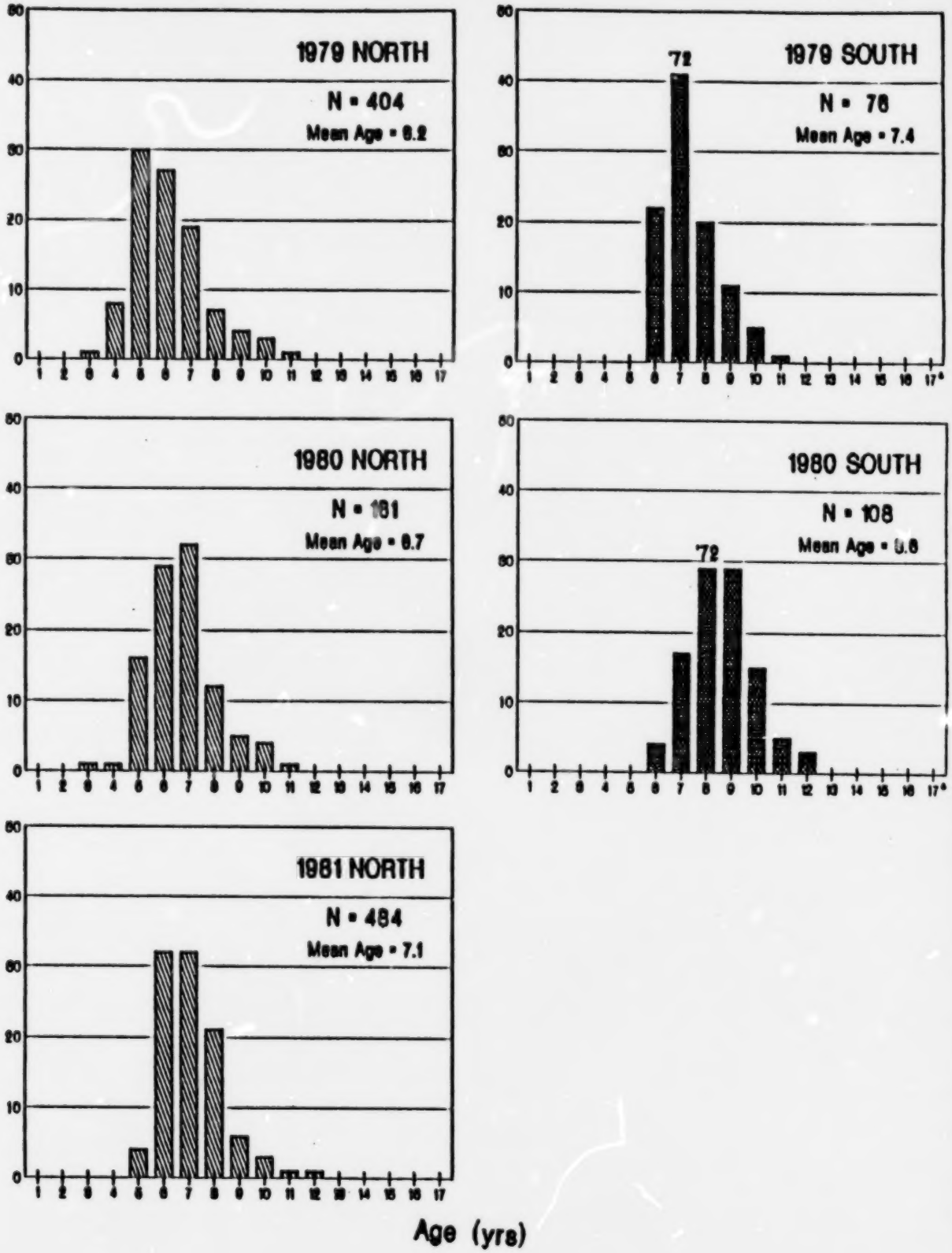
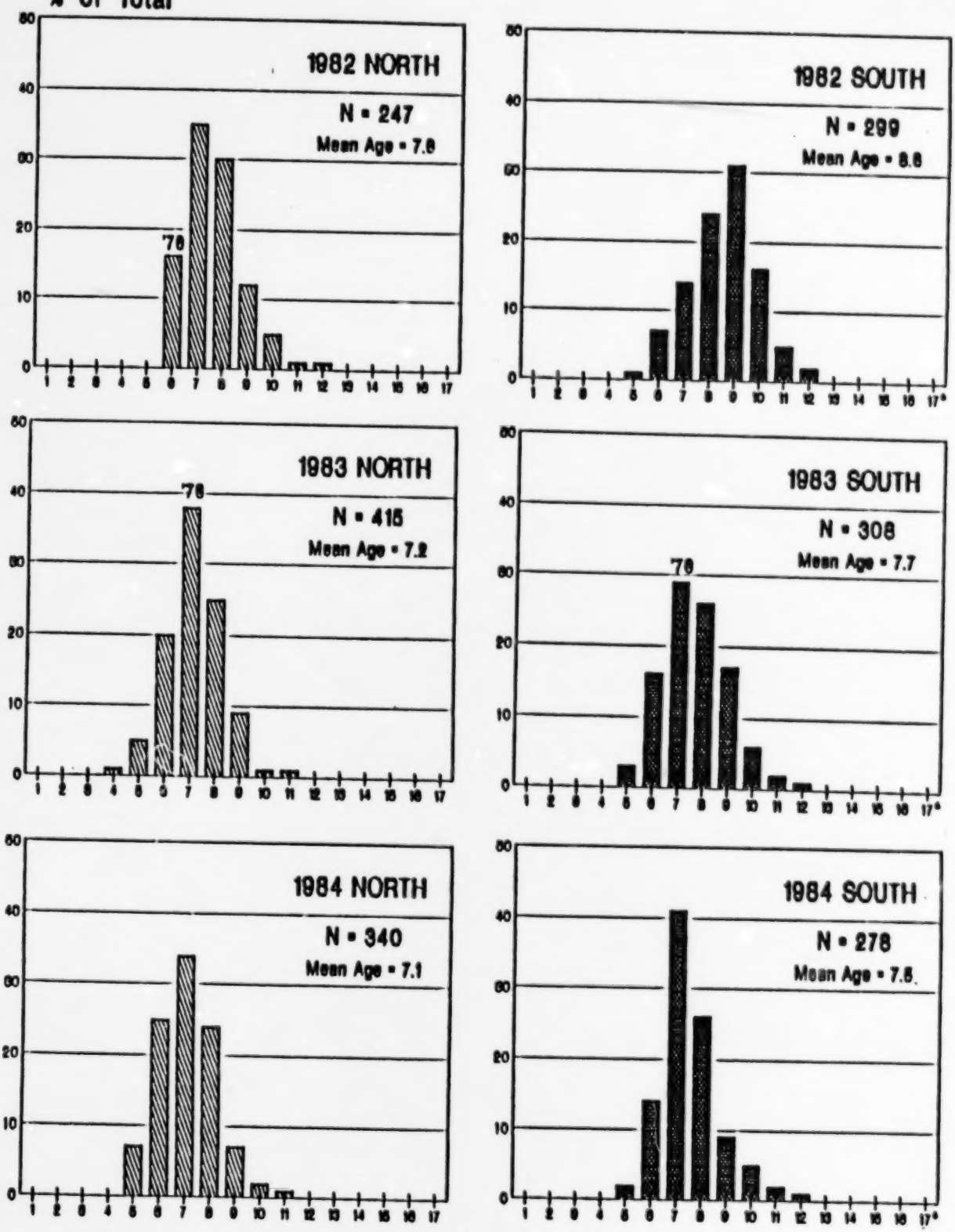


Appendix 1. Map indicating Lake Nipigon commercial data management zones based on fishing activity and current stock information.



Appendix 2. Age compositions of the 1979-1987 commercial Lake Whitefish catches sampled from North and South Lake Nipigon.



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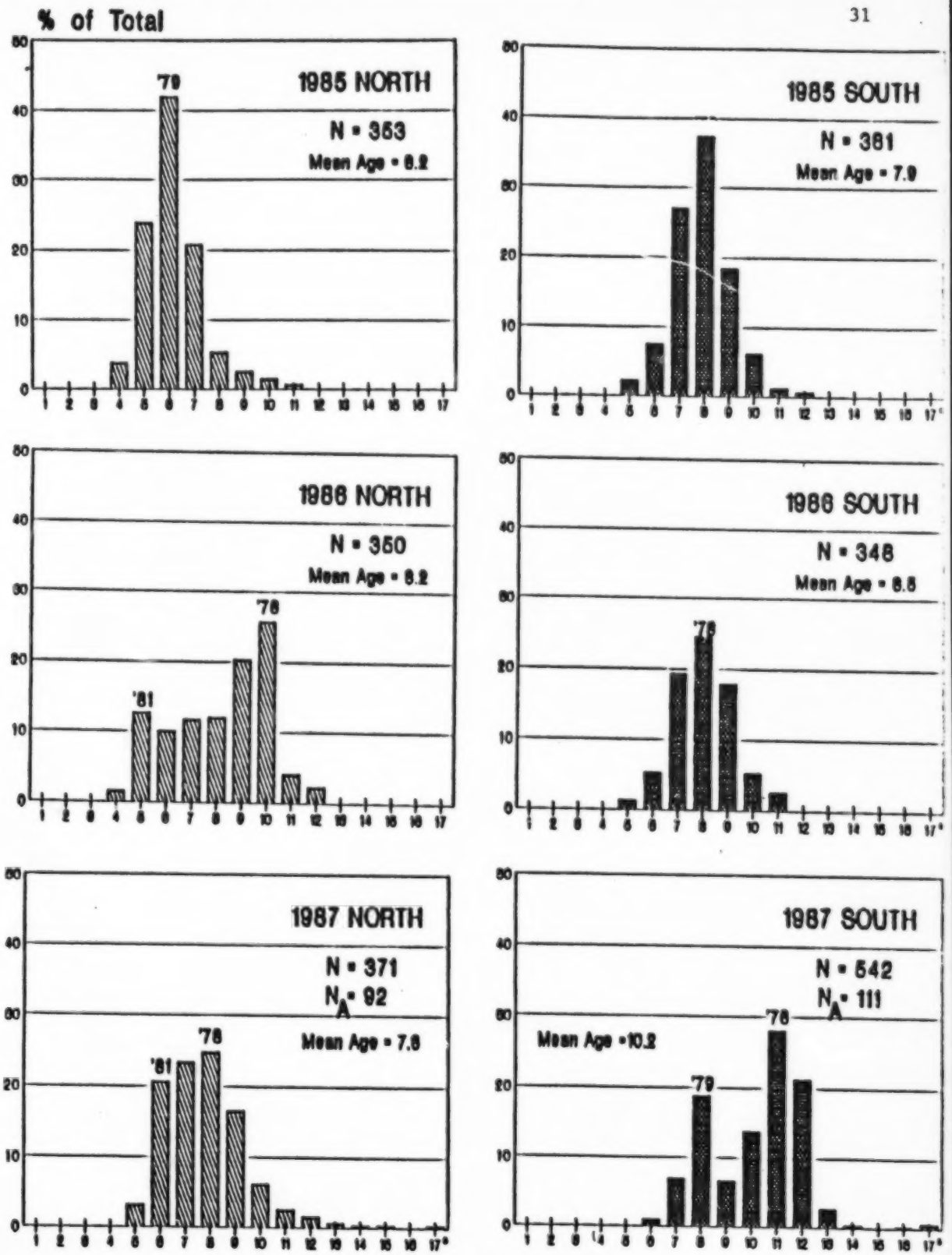

Appendix 2 Continued..

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